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United States Patent [19]

Zimmerman et al.

[11] **Patent Number:** 5,758,064[45] **Date of Patent:** May 26, 1998[54] **METHOD OF DIAGNOSING
COMMUNICATION PROBLEMS OF
ELECTRONIC PRICE LABELS**[75] Inventors: Terry L. Zimmerman, Lawrenceville;
John C. Goodwin, III, Suwanee;
Christopher M. Haynes, Doraville, all
of Ga.

[73] Assignee: NCR Corporation, Dayton, Ohio

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[51] Int. CL⁶ H04Q 1/00; G06F 15/24[52] U.S. Cl. 395/183.19; 340/825.54;
235/383[58] Field of Search 395/183.19, 214;
235/383, 385; 340/825.35, 825.17, 825.54,
825.49; 455/67.7; 364/574[56] **References Cited****U.S. PATENT DOCUMENTS**

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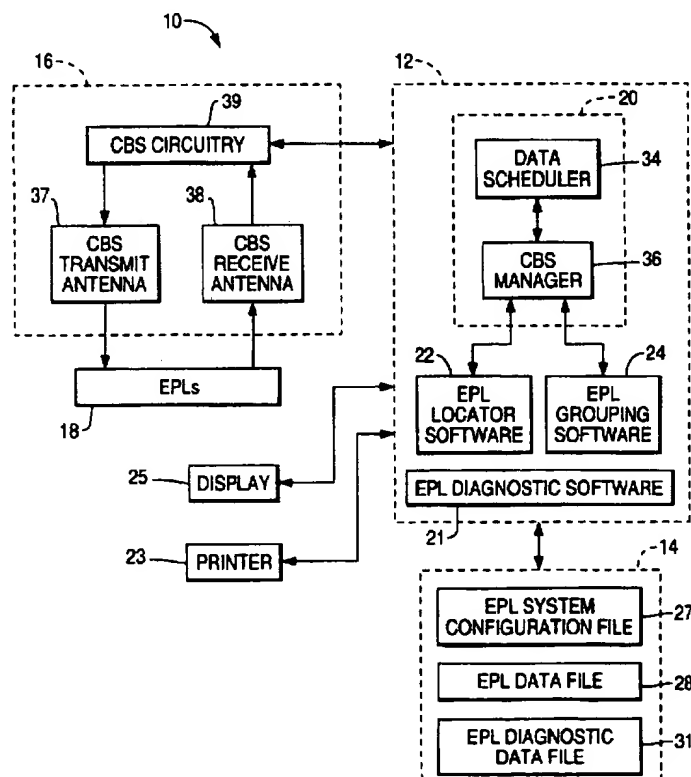
Primary Examiner—Robert W. Beausoliel

Assistant Examiner—Ly V. Hua

Attorney, Agent, or Firm—Paul W. Martin

[57] **ABSTRACT**

A method of diagnosing communication problems of electronic price labels in a transaction establishment which identifies the probable locations of the problems. The method includes the steps of assigning the electronic price labels to groups based upon their ability to receive a message from a computer, locating the electronic price labels, mapping locations of the electronic price labels, identifying a predetermined group of electronic price labels having the reception problems, and determining the cause of the reception problems.

24 Claims, 7 Drawing Sheets

US-PAT-NO: 5758064

DOCUMENT-IDENTIFIER: US 5758064 A

TITLE: Method of diagnosing communication problems of
electronic price labels

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Abstract Text - ABTX (1):

A method of diagnosing communication problems of **electronic price labels** in a transaction establishment which identifies the probable locations of the problems. The method includes the steps of assigning the **electronic price labels** to groups based upon their ability to receive a message from a computer, locating the **electronic price labels**, mapping locations of the **electronic price labels**, identifying a predetermined group of **electronic price labels** having the reception problems, and determining the cause of the reception problems.

TITLE - TI (1):

Method of diagnosing communication problems of **electronic price labels**

Parent Case Text - PCTX (2):

The present invention is related to commonly assigned and co-pending U.S. application entitled, "Method Of Locating **Electronic Price Labels** In Transaction Establishments", filed Oct. 5, 1995, invented by Goodwin, and having a Ser. No. 08/539,450.

Brief Summary Text - BSTX (2):

The present invention is related to commonly assigned and co-pending U.S. application entitled, "Method Of Locating **Electronic Price Labels** In Transaction Establishments", filed Oct. 5, 1995, invented by Goodwin, and having a Ser. No. 08/539,450.

Brief Summary Text - BSTX (4):

The present invention relates to **electronic price label (EPL)** systems used in transaction establishments, and more specifically to a method of diagnosing

communication problems of **electronic price labels**.

Brief Summary Text - BSTX (5):

EPL systems typically include a plurality of **EPLs** for each merchandise item in a store. **EPLs** typically display the price of corresponding merchandise items on store shelves and are typically attached to a rail along the leading edge of the shelves. A store may contain thousands of **EPLs** to display the prices of the merchandise items. The **EPLs** are coupled to a central server from where information about the **EPLs** is typically maintained in an **EPL** data file. Price information displayed by the **EPLs** is obtained from the PLU file.

Brief Summary Text - BSTX (6):

EPLs today may be wired or wireless. Wireless **EPLs** may employ infrared or radio frequency transmitters to transmit acknowledgment signals acknowledging receipt of messages and to relay acknowledgment signals from other **EPLs** to receiving devices coupled to a main **EPL** computer. An **EPL** only sends an acknowledgment if the message is addressed to it.

Brief Summary Text - BSTX (7):

EPLs typically differ on their ability to effectively receive and respond to messages from the central server. The primary causes for this difference are the location of **EPLs** within a transaction establishment and individual design differences among **EPLs**. Some **EPLs** may be located in areas of poor reception, where signals are attenuated more than in other areas.

Brief Summary Text - BSTX (8):

Therefore, it would be desirable to provide a method of diagnosing communication problems of **EPLs**. It would also be desirable to assign **EPLs** to groups based upon their ability to receive and transmit messages and to locate **EPLs** within each of the groups to determine the source of a reception problem.

Brief Summary Text - BSTX (10):

In accordance with the teachings of the present invention a method of diagnosing communication problems of **electronic price labels** is provided.

Brief Summary Text - BSTX (11):

The method includes the steps of assigning the **electronic price labels** to

groups based upon their ability to receive a message from a computer, locating the **electronic price labels**, mapping locations of the **electronic price labels**, identifying a predetermined group of **electronic price labels** having the reception problems, and determining the cause of the reception problems.

Brief Summary Text - BSTX (12):

A method of assigning **electronic price labels** to groups includes the steps of transmitting a number of messages to each **electronic price label**, transmitting return messages by a number of the **electronic price labels**, receiving the return messages, determining a signal-to-noise ratio for each of the return messages, establishing a plurality of groups based upon a plurality of signal-to-noise ratio thresholds, determining a highest signal-to-noise ratio threshold for each **electronic price label**, and assigning each **electronic price label** to a group corresponding to its highest signal-to-noise ratio threshold.

Brief Summary Text - BSTX (13):

The highest signal threshold is determined by the steps of determining a number of times the return messages from an **electronic price label** exceeds a highest signal-to-noise ratio threshold, and if the number exceeds a predetermined pass rate, then assigning the **electronic price label** to the group corresponding to the highest signal-to-noise ratio threshold. If the number is less than the predetermined pass rate for the highest signal-to-noise ratio threshold, then the method further includes the steps of determining a number of times the return messages from an **electronic price label** exceed each signal-to-noise ratio threshold below the highest signal-to-noise ratio threshold until the number exceeds one of the signal-to-noise ratio thresholds below the highest signal characteristic threshold, and assigning the **electronic price label** to the group corresponding to the one signal-to-noise ratio threshold.

Brief Summary Text - BSTX (14):

A method of locating **electronic price labels** includes the substeps of mapping locations of receiving antennae within the transaction establishment to a map, transmitting a number of messages to each **electronic price label**, transmitting return messages by a number of the **electronic price labels**, receiving the return messages by a number of receiving antennae, determining signal characteristics of the number of return messages at the number of receiving antennae, and determining locations of the number of **electronic price labels** relative to the locations of the number of receiving antennae from the map from the signal characteristics.

Brief Summary Text - BSTX (15):

It is accordingly an object of the present invention to provide a method of diagnosing communication problems of **electronic price labels**.

Brief Summary Text - BSTX (16):

It is another object of the present invention to provide a method of diagnosing communication problems of groups of **electronic price labels**.

Brief Summary Text - BSTX (17):

It is another object of the present invention to provide a method of assigning **electronic price labels** to groups.

Brief Summary Text - BSTX (18):

It is another object of the present invention to provide a method of locating **electronic price labels**.

Drawing Description Text - DRTX (3):

FIG. 1 is a block diagram of an **EPL** system;

Drawing Description Text - DRTX (4):

FIG. 2 is a block diagram of an **EPL**;

Drawing Description Text - DRTX (6):

FIG. 4 is a flow diagram illustrating the operation of **EPL** locator software;

Drawing Description Text - DRTX (7):

FIGS. 5A and 5B form a flow diagram illustrating a first method of grouping **EPLs**;

Drawing Description Text - DRTX (8):

FIG. 6 is a flow diagram illustrating the operation of **EPL** diagnostic software; and

Drawing Description Text - DRTX (9):

FIG. 7 is a flow diagram illustrating a second method of grouping EPLs.

Detailed Description Text - DETX (2):

Referring now to FIG. 1, EPL system 10 includes computer 12, storage medium 14, communication base station (CBS) 16a-d, and electronic price labels (EPLs) 18.

Detailed Description Text - DETX (3):

Computer 12 executes EPL control software 20, EPL diagnostic software 21, EPL locator software 22, and EPL grouping software 24. EPL control software 20 records, schedules, and transmits all messages to EPLs through CBS 16, and receives and analyzes status messages from EPLs 18 through CBS 16. EPL control software 20 also maintains and uses EPL data file 28, which contains item information, EPL identification information, item price verifier information, and status information for each of EPLs 18.

Detailed Description Text - DETX (4):

EPL control software 20 primarily includes data scheduler 34 and CBS manager 36. Data scheduler 34 schedules EPL price change messages to be sent to EPLs 18 through CBS 16.

Detailed Description Text - DETX (5):

EPL diagnostic software 21 identifies areas of a transaction establishment that may be causing poor reception of messages by EPLs in the vicinity of these areas. EPL diagnostic software 21 uses EPL location information and EPL group information stored within EPL configuration file 27. EPL diagnostic software 21 stores its results in EPL diagnostic data file 31.

Detailed Description Text - DETX (6):

EPL locator software 22 automatically monitors EPL system 10 for received signal strength and determines the location of identified EPLs within groups of

EPLs. **EPL** locator software 22 stores the location information in **EPL** system configuration file 27. **EPL** system configuration file 27 tells computer 12 how system 10 is configured, i.e., the addresses of **EPL** system components and there location within the transaction establishment relative to other components within system 10, and the location of different types of goods in system 10. **EPL** system configuration file 27 includes a map containing grid coordinates identifying the locations of **EPLs** 18 and CBSs 16.

Detailed Description Text - DETX (7):

EPL grouping software 24 organizes **EPLs** 18 into groups based upon their abilities to receive messages from CBSs 16. The groups may be based upon the number of message re-transmissions required for different signal strength and noise levels. If **EPLs** within a group having a high message retry rate are located within the same area of the transaction establishment, that area of the transaction establishment may have a barrier to effective transmission and reception. Upon inspection by personnel, this barrier may be isolated and removed.

Detailed Description Text - DETX (8):

Storage medium 14 is preferably a fixed disk drive. Storage medium 14 stores **EPL** system configuration file 27 and **EPL** data file 28.

Detailed Description Text - DETX (9):

CBS 16 necessarily includes at least one transmit antenna 37 and preferably includes one to four receive antennae 38 for transmitting and receiving messages between CBS 16 and **EPLs** 18. CBS 16 includes CBS circuitry 39 which controls operation of CBS 16. **EPL** system 10 preferably includes a plurality of CBSs 16 connected together in series.

Detailed Description Text - DETX (10):

CBS manager 36 transmits price change messages to **EPLs** 18 and receives status messages from **EPLs** 18 for predetermined time slots.

Detailed Description Text - DETX (11):

Turning now to FIG. 2, **EPLs** 18 are illustrated.

Detailed Description Text - DETX (12):

EPLs 18 each include battery 40, transmit and receive antenna 42, display 46, memory 47, and EPL circuitry 48.

Detailed Description Text - DETX (13):

Battery 40 provides power to EPLs 18.

Detailed Description Text - DETX (14):

Transmit and receive antenna 42 receives price change and status messages from CBS 16. For EPLs 18 designed for displaying blinking and non-blinking promotional messages, transmit and receive antenna 42 receives promotional messages as well.

Detailed Description Text - DETX (17):

Memory 47 stores price verifier information and EPL type information. Preferably, the price verifier information is a checksum of the displayed price. Memory 47 may also store other information, such as promotional information.

Detailed Description Text - DETX (18):

EPL circuitry 48 controls the internal operation of EPLs 18.

Detailed Description Text - DETX (19):

Turning now to FIG. 3, a map of a transaction establishment illustrates the location of shelves 50 and a predetermined group of EPLs 18 containing EPLs 18a

and 18b. This group may be defined by and contain EPLs having the highest message retry levels. Thus, it would be advantageous to attempt to diagnose the cause.

Detailed Description Text - DETX (20):

The locations of EPLs 18a and 18b within the group are determined using EPL locator software 22 and are referenced to a two-dimensional coordinate system in which rows are identified by numerals and columns are identified by letters.

Detailed Description Text - DETX (22):

In this example, EPLs 18a are located in close proximity to each other, while EPLs 18b are scattered throughout the transaction establishment. Looking at the map, a store employee may assume that the high retry level for EPLs 18a in the sub-group are due to a common external cause. Thus, the store employee may look in the vicinity of EPLs 18a and shelf 51 to determine the cause for the high retry level. The store employee may also look at EPLs surrounding EPLs 18a to determine whether retry levels improve with radial distance from the center of the group containing EPLs 18a. For the other EPLs 18b within the group, the store employee may look at adjacent EPLs having different retry levels to determine whether the high retry levels for the EPLs 18b are more likely caused by internal or external problems.

Detailed Description Text - DETX (23):

Turning now to FIG. 4, the operation of EPL locator software 22 is explained in more detail, beginning with START 60.

Detailed Description Text - DETX (24):

In step 61, EPL control software causes CBSs 16 to transmit a query message to a particular EPL.

Detailed Description Text - DETX (25):

In step 62, EPL locator software 22 listens for an acknowledgment message from the EPL.

Detailed Description Text - DETX (26):

In step 64, EPL locator software 22 determines the signal strengths and noise levels of any acknowledgment message from the EPL to one of antennae 38 within CBSs 16.

Detailed Description Text - DETX (27):

In step 66, EPL locator software 22 determines whether signal strength information for the last of antennae 38 has been determined. If all CBSs 16 have been polled for signal strength information about their antennae 38, the method continues to step 68. If a CBS has not been polled, the method returns to step 64.

Detailed Description Text - DETX (28):

In step 68, EPL locator software 22 determines the primary and secondary estimates of fixes from map information stored within EPL configuration file 27. If multiple antennae 38 receive the acknowledgment message, EPL locator software 22 uses basic radar tracking methods to determine the location of the EPL.

Detailed Description Text - DETX (29):

In step 70, EPL locator software 22 optionally converts the fixes to types of goods using information in EPL configuration file 27.

Detailed Description Text - DETX (30):

In step 72, EPL locator software 22 displays and/or prints primary and secondary estimates of the location coordinates and/or types of goods where the desired EPL is most likely located.

Detailed Description Text - DETX (31):

If store personnel determine that the location of the EPL does not correspond to its location in EPL configuration file 27 (e.g., because a child has removed it and placed it somewhere else), they can place the EPL in its proper location.

Detailed Description Text - DETX (32):

In step 74, EPL locator software 22 stores the determined fixes in EPL configuration file 27 for use by EPL diagnostic software 21.

Detailed Description Text - DETX (34):

Turning now to FIG. 5, EPL grouping software 24 is explained in more detail, beginning with START 80.

Detailed Description Text - DETX (35):

In step 82, EPL grouping software 24 transmits messages to an EPL. EPL grouping software 24 preferably sends 10-200 messages to each EPL.

Detailed Description Text - DETX (36):

In step 84, EPL grouping software 24 determines signal strength and noise levels of return messages.

Detailed Description Text - DETX (37):

In step 86, EPL grouping software 24 sets the current retry level to the first retry level, which is arbitrarily chosen by the transaction establishment. For example, a message retry of `1` may be the highest and have an associated minimum signal strength of `68` and a maximum noise level of `57`. A message retry of `2` may be the next highest and have an associated minimum signal strength of `64` and a maximum noise level of `58`. Additional retry levels reflecting ever decreasing performance are also preferably determined.

Detailed Description Text - DETX (38):

In step 88, EPL grouping software 24 determines how many times the EPL passes the minimum signal-to-noise ratio for the current retry level. In the example provided, after EPL grouping software 24 has received messages from the EPL, EPL grouping software 24 determines the number of times the measured signal strengths and noise levels meet the criteria for a message retry of `1`.

Detailed Description Text - DETX (39):

In step 90, EPL grouping software determines whether the pass rate is greater than the minimum for the current level.

Detailed Description Text - DETX (40):

EPL grouping software 24 assigns the EPL to a group having a first message retry level of `1` in step 98 if the pass rate is above the predetermined minimum pass rate.

Detailed Description Text - DETX (41):

If the pass rate is below the predetermined minimum pass rate, EPL grouping software 24 determines whether the current retry level is the last retry level in step 92. If it is not, then EPL grouping software 24 sets the current retry level to the next retry level in step 94 and returns to step 88 to determine whether the measured signal strengths and noise levels meet the criteria for the next retry level.

Detailed Description Text - DETX (42):

Returning to step 92, if the current retry level is the last retry level, then EPL grouping software 24 assigns the EPL to a group characterized as non-functioning in step 96. This group is monitored by employees who replace non-functioning EPLs with new EPLs.

Detailed Description Text - DETX (43):

From both steps 96 and 98, EPL grouping software 24 enters the group information in EPL data file 28 and may also enter the group information in EPL configuration file 27 in step 100. The information may be viewed using display 25 or printed using printer 23.

Detailed Description Text - DETX (44):

In step 102, EPL grouping software 24 determines whether the current EPL is the last EPL. If it is not, the method returns to step 82 to examine another EPL.

Detailed Description Text - DETX (45):

If it is the last EPL, the method ends in step 104.

Detailed Description Text - DETX (46):

Turning now to FIG. 6, EPL diagnostic software 21 is explained in more detail, beginning with START 110.

Detailed Description Text - DETX (47):

In step 112, EPL diagnostic software 21 identifies a predetermined target group of EPLs 18 from EPL configuration file 27. This group may be the one with the highest retry level, although any group having less than optimal retry levels may be chosen. For purposes of this example, the group is assumed to be a single cohesive group, rather than a plurality of subgroups.

Detailed Description Text - DETX (48):

In step 114, EPL diagnostic software 21 determines the primary CBS that communicates with the EPLs in the target group from EPL configuration file 27.

Detailed Description Text - DETX (49):

In step 118, EPL diagnostic software 21 determines the grid coordinates for

the primary antenna of the primary CBS from EPL configuration file 27. For purposes of this example, it is assumed that only one CBS antenna communicates with EPLs in the target group.

Detailed Description Text - DETX (50):

In step 124, EPL diagnostic software 21 determines an adjacent group between the primary antenna and the target group.

Detailed Description Text - DETX (51):

In step 126, EPL diagnostic software 21 determines the retry levels for the adjacent group from EPL configuration file 27.

Detailed Description Text - DETX (52):

In step 128, EPL diagnostic software 21 determines the difference between the retry level for the target group and the retry level for the adjacent group.

Detailed Description Text - DETX (53):

In step 130, EPL diagnostic software 21 determines whether the difference exceeds one retry level. If it does, the reception problem is most likely in the vicinity of the target group. EPL diagnostic software 24 logs the grid coordinates between the target group and the adjacent group in EPL diagnostic data file 31 in step 132. The method ends in step 138.

Detailed Description Text - DETX (54):

If the difference does not exceed one retry level, EPL diagnostic software 21 determines whether there are any additional groups between the target group and the primary antenna in step 134. If there are not, the method ends in step 138. If none of the differences between intermediate groups exceeds one retry level, then the reception problem is most likely caused by the CBS or by an insufficient number of CBSs.

Detailed Description Text - DETX (55):

If there is an additional intermediate group between the target group and the primary antenna, EPL diagnostic software 21 designates the current adjacent

group as the target group and the additional intermediate group as the current adjacent group in step 136 and the method returns to step 124.

Detailed Description Text - DETX (57):

Advantageously, the method of the present invention may be used after EPLs 18 have been installed to tune EPL system 10 for higher reliability and performance.

Detailed Description Text - DETX (58):

Turning now to FIG. 7, a second method for assigning EPLs 18 to groups is illustrated, beginning with START 140.

Detailed Description Text - DETX (59):

In step 142, EPL locator software 22 reads EPL data file 28.

Detailed Description Text - DETX (60):

In step 144, EPL locator software 22 identifies a group associated with a particular EPL. The group identity may be determined from a group number, or by comparing the EPL serial number against a group range of serial numbers, or by comparing an EPL installation date against a range of group dates.

Detailed Description Text - DETX (61):

In step 146, EPL locator software 22 instructs the EPL to load its memory 47 with information identifying the group. This display information may be a group number, a blinking group number, a promotional message, or a blinking promotional message.

Detailed Description Text - DETX (62):

In step 148, EPL locator software 22 instructs the EPL to display the contents of its memory 47.

Detailed Description Text - DETX (63):

In step 150, EPL locator software 22 determines whether it has read information for the last EPL in EPL data file 28. If not, the method returns to step 142. If so, the method proceeds to step 152.

Detailed Description Text - DETX (64):

In step 152, EPLs 18 and their groups are mapped to coordinates by employees. The employees view each EPL and log the displayed group number with the EPL's identification number.

Claims Text - CLTX (1):

1. A method of managing groups of electronic price labels in a transaction establishment comprising the steps of:

Claims Text - CLTX (2):

(a) assigning the electronic price labels to the groups based upon their ability to receive a message from a computer;

Claims Text - CLTX (3):

(b) locating the electronic price labels within the groups;

Claims Text - CLTX (4):

(c) mapping locations of the electronic price labels and their groups;

Claims Text - CLTX (5):

(d) identifying a predetermined group of electronic price labels having problems receiving messages from a computer; and

Claims Text - CLTX (6):

(e) determining the cause of the reception problems using the locations of electronic price labels within the one group.

Claims Text - CLTX (9):

(b-2) transmitting a number of messages to each electronic price label;

Claims Text - CLTX (10):

(b-3) transmitting return messages by a number of the electronic price labels;

Claims Text - CLTX (13):

(b-6) determining locations of the number of **electronic price labels** relative to the locations of the number of receiving antennae from the map from the signal characteristics.

Claims Text - CLTX (15):

(b-6-A) using radar tracking methods to determine a location of one of the **electronic price labels** if a plurality of receiving antennae receive a return message from the one **electronic price label**.

Claims Text - CLTX (17):

(b-1) transmitting a message to the **electronic price labels** instructing the **electronic price labels** to load their memories with information identifying the groups they are in; and

Claims Text - CLTX (18):

(b-2) recording a location for each **electronic price label** and its group.

Claims Text - CLTX (20):

(a-1) transmitting a number of messages to each **electronic price label**;

Claims Text - CLTX (21):

(a-2) transmitting return messages by a number of the **electronic price labels**;

Claims Text - CLTX (25):

(a-6) determining a highest signal characteristic threshold for each **electronic price label**; and

Claims Text - CLTX (26):

(a-7) assigning each **electronic price label** to a group corresponding to its highest signal characteristic threshold.

Claims Text - CLTX (28):

(a-7-1) determining a number of times the return messages from an **electronic price label** exceed a highest signal characteristic threshold;

Claims Text - CLTX (29):

(a-7-2) if the number exceeds a predetermined pass rate for the highest signal characteristic threshold, assigning the electronic price label to the group corresponding to the highest signal characteristic threshold;

Claims Text - CLTX (30):

(a-7-3) if the number is less than the predetermined pass rate for the highest signal characteristic threshold, determining a number of times the return messages from an electronic price label exceed each signal characteristic threshold below the highest signal characteristic threshold until the number exceeds one of the signal characteristic thresholds below the highest signal characteristic threshold; and

Claims Text - CLTX (31):

assigning the electronic price label to the group corresponding to the one signal characteristic threshold.

Claims Text - CLTX (34):

(e-1) identifying additional groups of electronic price labels between an antenna and the predetermined group of electronic price labels;

Claims Text - CLTX (41):

(c-2) plotting the locations of the electronic price labels on the reference grid.

Claims Text - CLTX (44):

(d-1) transmitting a number of messages to each electronic price label;

Claims Text - CLTX (45):

(d-2) transmitting return messages by a number of the electronic price labels;

Claims Text - CLTX (54):

15. A method of assigning electronic price labels to groups comprising the steps of:

Claims Text - CLTX (55):

(a) transmitting a number of messages to each electronic price label;

Claims Text - CLTX (56):

(b) transmitting return messages by a number of the electronic price labels;

Claims Text - CLTX (60):

(f) determining a highest signal characteristic threshold for each electronic price label; and

Claims Text - CLTX (61):

(g) assigning each electronic price label to a group corresponding to its highest signal characteristic threshold.

Claims Text - CLTX (63):

(g-1) determining a number of times the return messages from an electronic price label exceeds a highest signal characteristic threshold;

Claims Text - CLTX (64):

(g-2) if the number exceeds a predetermined pass rate for the highest signal characteristic threshold, assigning the electronic price label to the group corresponding to the highest signal characteristic threshold;

Claims Text - CLTX (66):

determining a number of times the return messages from an electronic price label exceed each signal characteristic threshold below the highest signal characteristic threshold until the number exceeds one of the signal characteristic thresholds below the highest signal characteristic threshold; and

Claims Text - CLTX (67):

assigning the electronic price label to the group corresponding to the one signal characteristic threshold.

Claims Text - CLTX (69):

18. A method of locating one group of electronic price labels out of a number of groups of electronic price labels comprising the substeps of:

Claims Text - CLTX (71):

(b) assigning the electronic price labels to the groups based upon their ability to receive messages from a computer;

Claims Text - CLTX (72):

(c) transmitting a number of the messages to electronic price labels, including a command to load their memories with information identifying the groups they are in;

Claims Text - CLTX (73):

(d) transmitting return messages by a number of the electronic price labels within the one group;

Claims Text - CLTX (76):

(g) determining locations of the number of electronic price labels within only the one group relative to the locations of the number of receiving antennae from the map from the signal characteristics; and

Claims Text - CLTX (77):

(h) recording a location for each electronic price label in the one group.

Claims Text - CLTX (79):

(g-1) using radar tracking methods to determine a location of one of the electronic price labels if a plurality of receiving antennae receive a return message from the one electronic price label.

Claims Text - CLTX (80):

20. A method of managing groups of electronic price labels in a transaction establishment comprising the steps of:

Claims Text - CLTX (81):

(a) assigning the electronic price labels to the groups based upon their

ability to receive a message from a computer, including the substeps of (a-1) transmitting a number of messages to each **electronic price label**;

Claims Text - CLTX (82):

(a-2) transmitting return messages by a number of the **electronic price labels**;

Claims Text - CLTX (86):

(a-6) determining a highest signal characteristic threshold for each **electronic price label**; and

Claims Text - CLTX (87):

(a-7) assigning each **electronic price label** to a group corresponding to its highest signal characteristic threshold;

Claims Text - CLTX (88):

(b) locating the **electronic price labels** within the groups;

Claims Text - CLTX (89):

(c) mapping locations of the **electronic price labels** and their groups;

Claims Text - CLTX (90):

(d) identifying a predetermined group of **electronic price labels** having problems receiving messages from a computer; and

Claims Text - CLTX (91):

(e) determining the cause of the reception problems using the locations of **electronic price labels** within the one group.

Claims Text - CLTX (93):

(a-7-1) determining a number of times the return messages from an **electronic price label** exceed a highest signal characteristic threshold;

Claims Text - CLTX (94):

(a-7-2) if the number exceeds a predetermined pass rate for the highest

signal characteristic threshold, assigning the **electronic price label** to the group corresponding to the highest signal characteristic threshold;

Claims Text - CLTX (95):

(a-7-3) if the number is less than the predetermined pass rate for the highest signal characteristic threshold, determining a number of times the return messages from an **electronic price label** exceed each signal characteristic threshold below the highest signal characteristic threshold until the number exceeds one of the signal characteristic thresholds below the highest signal characteristic threshold; and

Claims Text - CLTX (96):

assigning the **electronic price label** to the group corresponding to the one signal characteristic threshold.

Claims Text - CLTX (97):

22. A method of assigning **electronic price labels** to groups comprising the steps of:

Claims Text - CLTX (98):

(a) transmitting a number of messages to each **electronic price label**;

Claims Text - CLTX (99):

(b) transmitting return messages by a number of the **electronic price labels**;

Claims Text - CLTX (103):

(f) determining a highest signal characteristic threshold for each **electronic price label**; and

Claims Text - CLTX (104):

(g) assigning each **electronic price label** to a group corresponding to its highest signal characteristic threshold, including the substeps of (g-1) determining a number of times the return messages from each **electronic price label** exceeds a highest signal characteristic threshold;

Claims Text - CLTX (105):

(g-2) if the number exceeds a predetermined pass rate for the highest signal characteristic threshold, assigning the **electronic price label** to the group corresponding to the highest signal characteristic threshold; and

Claims Text - CLTX (106):

(g-3) if the number is less than the predetermined pass rate for the highest signal characteristic threshold, determining a number of times the return messages from an **electronic price label** exceed each signal characteristic threshold below the highest signal characteristic threshold until the number exceeds one of the signal characteristic thresholds below the highest signal characteristic threshold, and assigning the **electronic price label** to the group corresponding to the one signal characteristic threshold.

Claims Text - CLTX (107):

23. A method of diagnosing a reception problem of a target group of **electronic price labels (EPLs)** comprising the steps of:

Claims Text - CLTX (108):

determining locations of the **EPLs** within the target group;

Claims Text - CLTX (109):

determining a location of an antenna which transmits messages to the **EPLs** within the target group;

Claims Text - CLTX (112):

determining locations of **EPLs** within the additional groups;

Claims Text - CLTX (116):

correlating the second difference with the locations of the **EPLs** within the groups to determine a location of the reception problem.